Report for 2001NC801B: Reuse of Wastewater from Septic Systems

There are no reported publications resulting from this project.

Report Follows:

Problem and Research Objectives: Approximately 50% of the people living in North Carolina, and 25% of the United States population, use septic systems for on-site management of their sewage. Based on the estimated number of people living in a residential dwelling (2.9 people), and the average amount of wastewater produced by each individual (170 L/d), the volume of wastewater dispersed into North Carolina soils through septic systems could exceed 1 billion L/d (275 million gal/d). Approximately an equal volume of wastewater is treated and disposed of through public sewer facilities in North Carolina. Wastewater treated by large sewage facilities is being used for irrigating agricultural and non-agricultural crops (e.g., golf courses, home lawns). However, little has been done for the on-site reuse of the partially treated wastewater from septic systems as irrigation water for ornamental plants and lawns. According to the EPA, the average volume of sewage generated within a residential dwelling arises from toilet facilities (35%), laundry (22%), shower/bath and lavatory sinks (20%), and the kitchen (10%). The remaining 13% comes from other sources (e.g., a water softener) within the dwelling. It is possible that some of the wastewater generated in residential dwellings, referred to as graywater, could be used for irrigation on-site following minimal treatment. The overall goal of this study is to determine the potential reuse of graywater from laundry and wastewater from kitchen dishwashing machines for irrigating at a residential landscape. The specific objectives of the study are: (1) to assess the effect of wastewater from laundry and kitchen facilities of residential dwellings on soil hydraulic conductivity, and to determine the impact of surfactants and sodium hypochlorite present in laundry products on soil hydraulic conductivity and water retention, and 2) to evaluate the effects of untreated household wastewater generated by kitchen and laundry facilities plus a calcium amendment on growth and appearance of selected ornamental plants.

Methodology: This is a laboratory-greenhouse study to assess the impact of graywater on selected soils and selected ornamental plants. To evaluate the characteristics of graywater a sampling device was designed and constructed to collect wastewater samples from a laundry machine outlet and the sink receiving effluent from a dishwashing machine. Wastewater samples were collected from the homes of a number of volunteers and analyzed for selected chemicals. Additional samples will be collected from the homes of volunteers. Sixty intact core samples, 6.5 cm in diameter and over 10 cm long, were collected from the Bt horizon of a clayey soil, a sandy soil, and a saprolite. Each intact core was covered with paraffin, trimmed to an 8-cm length, and a 2.5-inch polyvinyl chloride (PVC) fitting was attached to one end of it. Saturated hydraulic conductivity (K_{sat}) of five samples from each of three soils (15 cores) was measured with water over a 5-day period. Another five cores from each of the soils were used to measure their K_{sat} using wastewater from washing machines over a 9-day period. At the termination of the K_{sat} measurements, each core was trimmed to 7 cm length and analyzed for soil water retention under 0, 25, 50, 75, 100, 150, 200, 300, and 400 cm of tension. Saturated hydraulic conductivity for laundry wastewater and the laundry-dishwashing combination wastewater, as well as the soil water retention of the remaining core samples will be measured during the remainder of the project period. In addition, the aggregate stability of the core samples following wastewater application to the cores will be assessed. Additional intact core samples will be collected to assess the impact of sodium and surfactants on soil hydraulic properties. To conduct the greenhouse study,

two different top soils were obtained and preparations were made to grow ornamental plants to be irrigated with water, laundry wastewater, dishwashing wastewater, and laundry wastewater plus a calcium amendment.

Principal Findings and Significance: This study will be continued through the end of November 2002. The preliminary results show that the K_{sat} of the Bt horizon core samples was increased during the 2nd day of measurement, but decreased to an average value ranging between 2.4 and 3.4 cm/day after the third day. The average saturated hydraulic conductivity of the sandy soil remained between 6 and 7 cm/d for five days. Saturated hydraulic conductivity of the Bt and the sandy soils decreased substantially after applying laundry wastewater to them. The K_{sat} of both soils reached the low value of 0.5 cm/d and remained below 1 cm/d after 5 days of laundry wastewater application. The measured K_{sat} values for the saprolite cores for both water and laundry wastewater were unusually low. After inspecting these cores, we determined that the cores did not represent the saprolite found at the site. Another set of saprolite samples will be collected to replace these samples. Based on the water retention under various soil water pressure heads, the sandy soil contains 30% water by volume at saturation with approximately 40% of the pores draining under 100 cm of tension. The total porosity of saprolite was approximately 55% while the porosity of the Bt horizon was approximately 47%. The average water content of the saprolite under 400 cm of tension was the same as the average water content of the Bt horizon.

Awards, Honors, promotions: None

Publications: None